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Electron Yield of Challenging Materials: Low Density Polyethylene and Carbon-composite Nanodielectrics

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Abstract

The electron yield—the ratio of the number of emitted electrons to incident electrons—is a key material property that characterizes how materials will charge due to exposure to electron fluxes. The USU Materials Physics Group has developed expertise in measuring this for a wide array of conductors, semiconductors and insulators, including many challenging materials. The basic definitions associated with electron yield and how they are measured will be discussed. We will highlight many critical applications investigated at USU, particularly those associated with spacecraft charging as materials interact with space plasma environments. Electron irradiation experiments conducted to investigate the electron transport, charging, discharging, and emission properties of two challenging and technologically useful materials are discussed. The first is the most structurally simple polymeric material, low density polyethylene (LDPE). The electron yield of this ubiquitous thermoplastic is influenced by the material's very low conductivity and high negative electron affinity. Similar experiments were performed on an epoxy/carbon-fiber composite material used in extreme applications to understand how the results are influenced by the nanoscale structure of the conducting carbon fibers embedded in the dielectric epoxy matrix.

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